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ABSTRACT

This paper explores how preservice mathematics teachers perceive the use of hypermedia in instruction. Six preservice mathematics teachers at the University of Texas at Austin were given a questionnaire in order to determine their prior knowledge of browsing the Internet, authoring on the Internet, and using CD-ROMs for both personal and instructional purposes. Student work and qualitative data from observations and informal discussions were also collected. Results indicate that the teachers had a greater knowledge of Internet and CD-ROM use for personal purposes than for instructional. The study also shows that few of the teachers had experience with authoring on the Internet for instructional or personal purposes. Although the results provide some evidence that there is a need to introduce preservice secondary mathematics teachers to computer technology so that they may integrate technologies in their classrooms, it is clear research is needed to determine whether hypermedia resources are effective in mathematics instruction and if so, how they should be used and when they are appropriate for the classroom. Questionnaire is appended. (Contains 26 references.) (MA)

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Introducing Preservice Mathematics Teachers to Hypermedia

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Abstract

Preservice secondary mathematics teachers were introduced to two hypermedia resources: CD-ROMs and the Internet. This study examined preservice teachers perceptions of the use of hypermedia in instruction and how hypermedia affected their attitudes toward teaching.

RESEARCH FRAMEWORK/RELATED LITERATURE

The use of hypermedia in instruction is becoming more prevalent. Even though very few classrooms currently have the technology available to support the use of hypermedia, every classroom in America may eventually have access to a computer. The increase in availability of computers in the schools places a large demand on teachers to use technology in their classroom. Studies from the past two decades indicate that the introduction of computers and the use of technology in the classroom have changed instruction and the role of the teacher (Fawson & Smellie, 1990; Savenye & *Piña*, 1992; Simpson, 1984; Stager & Green, 1988; Stallard, 1982). It is thus important for teachers to understand the purpose of technology in instruction and become knowledgeable about the available resources. Some teachers, however, may misunderstand the function of technology in education, and several continue to be uncertain as to how to integrate effectively the computer technology with the curriculum in the classroom (Westhoff, 1992; Moore, 1995). As a result, the number of teachers who are beginning to use technology in their classroom is much lower than the rate at which computers are becoming available in the schools (Sheingold & Hadley, 1990).

Many teachers are interested in using computer technologies in their classroom; unfortunately, there are not many who are proficient at using the newer technologies such as videodiscs, hypermedia, and telecommunications (Topp, 1993). In addition, the demands of teaching may make it difficult for teachers to find time to learn the technology and how to implement it effectively, although many have a positive attitude toward the importance of

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using computers in education (Topp, 1993). Research has shown that educating teachers in computer technology promotes effective implementation of technology in the classroom (Kearsley & Seidel, 1985). This suggests the need to introduce various technology resources in a teacher preparation program so that preservice teachers gain the knowledge to use technology effectively in the classroom.

Several studies have already addressed the importance and usefulness of introducing inservice and preservice teachers to technology (Westhoff, 1992; Russett, 1995; Day, 1995; Wellington, 1995; Bright & Waxman, 1993; Ayersman, 1994) so that they may learn the technology and understand how it might be integrated in the classroom. More recent research studies have focused on the newer technologies at different levels of instruction and their impact on education. Unfortunately, the literature contains very few studies which investigate the use of the newer technologies, specifically CD-ROMs and the Internet, in a secondary mathematics teacher education program.

In general, teacher education programs focus on developing knowledge, skills, and applications (Fitzgerald, 1994), but they lack providing the connecting link between the knowledge acquired in methods courses and its application in the classroom (Rule & Salzberg, 1988). Munby and Russell (1994) explored how novice teachers can learn from experiences offered in preservice teacher education programs. In particular, learning how to use the computer for instructional or managerial purposes should be introduced in teacher education programs. Overbaugh (1994) used a simulation program that emphasized classroom situations in order to teach basic principles of classroom management. Although there is no supporting research, the proper implementation of computers in a teacher education program may provide the connecting link for teachers to make the connection between the material learned in their methods courses and the application of it in the classroom.

If technology is implemented within a teacher education program, it is essential for both teacher educators and teachers to keep current with technology resources in order to create contiguity between the knowledge and skills learned in preservice courses and their

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actual application in the classroom. Hypermedia is one of the newer technologies that is being researched in the schools and introduced in teacher development programs. Learning with hypermedia in a teacher preparation program has been shown to be both frustrating and enjoyable from the perspective of preservice teachers, but nevertheless can create more capable teachers (Carr, 1993). Further studies have claimed that hypermedia is "an educationally valuable tool" (Shapiro, 1994), that students can learn from a combined computer-based and hypermedia instructional environment (Vullo, 1994), and that hypermedia can be used in educational reform which may effect the role of both the teacher and the student (Kirby, 1993). Thus, it is important to introduce hypermedia in education and, particularly, in preservice teacher education.

As noted by Wisnudel (1994), hypermedia can be used to represent a single concept from multiple perspectives. In mathematics, hypermedia could then aid students in exploring a mathematical concept in various ways so that they may gain a better understanding of the concept. Whether hypermedia can be integrated effectively in secondary mathematics instruction remains to be studied. The present study is an attempt to understand preservice secondary mathematics teachers' perceptions about the use of hypermedia in mathematics instruction.

PURPOSE AND RESEARCH QUESTIONS

The purpose of the present study was to examine preservice teachers' perceptions regarding the use of hypermedia in secondary mathematics instruction, and whether hypermedia affected their attitudes toward teaching. The research questions were (1) How do preservice mathematics teachers perceive the use of hypermedia in instruction? (2) How does the use of hypermedia affect the attitudes of preservice mathematics teachers toward teaching? and (3) Does their vision of teaching change?

METHOD

Participants

Six preservice secondary mathematics teachers participated in this study, five females and one male. All subjects were Caucasian/non-hispanic and were undergraduates in their junior or senior year of school. These students were enrolled in a practicum course in a special program for the preparation for mathematics teaching at the University of Texas at Austin . The program, called "p4m," is currently in its developmental stage so the faculty are experimenting with new and innovative ideas to be used in the program. This situation was appropriate for the author to gather information on the views of the participants about the use of hypermedia in mathematics instruction.

Treatment

The preservice secondary mathematics teachers (PSMTs) were introduced to two hypermedia resources: CD-ROMs and the Internet. A questionnaire was given to determine the PSMTs prior knowledge of browsing the Internet, authoring on the Internet, and using CD-ROMs for both personal and instructional purposes. The questionnaire also contained 47 Likert scale questions which were used to assess the PSMTs' attitudes toward the use of hypermedia in schooling and the personal use of hypermedia. This part of the questionnaire was administered both as a pretest and as a posttest. Student work and qualitative data from observations and informal discussions was collected to help examine the PSMTs' perceptions regarding the use of hypermedia in secondary mathematics instruction, and determine whether hypermedia affected their attitudes toward teaching.

The student work that was used to examine the PSMTs' perceptions and attitudes toward the use of hypermedia in mathematics instruction included two hypermedia assignments and two non-hypermedia assignments. The Internet was the hypermedia resource used in both of the hypermedia assignments, while newspaper and journal articles were the resources for the non-hypermedia assignment. In each of the two assignments, one hypermedia and one non-hypermedia assignment were similar, so that the students could have

perspectives from both a hypermedia and a non-hypermedia approach. An example of the introduction within the non-hypermedia and hypermedia assignments are provided in Table 1.

Non-hypermedia Assignment	As you know, real world applications are very useful in teaching concepts and helping students to make a connection with the material. In this assignment you are to use a newspaper to find an article or advertisement and create your own classroom project based on that information. In your own classroom you may want to consider requiring the students to bring a newspaper to class and do an in-class project. You may design your project in this manner.
Hypermedia Assignment	In this assignment you are to use the Internet to create a lesson plan that can be given during one class period. Some of the areas you might consider include: arithmetic, geometry, algebra, trigonometry, calculus, probability, and statistics. The purpose of this assignment is to use the computer to provide students with an alternative approach to learning a particular mathematical concept.

Table 1. Example of the introduction within a non-hypermedia and hypermedia assignment.

The PSMTs reviewed several CD-ROMs for the study in between the administration of the pretest and posttest questionnaire. The CD-ROMs reviewed in the study were *Stickybear's Math Town*, *The Talking Math Bee*, *The Math School*, *Math Workshop*, and *SimCity 2000*.

The *SimCity 2000* program is a simulation game that allows the user to be the planner, designer, and mayor of a city. The program *Math Workshop* contains a collection of mathematical activities. The other CD-ROMs used in the study are mainly used for practicing arithmetic skills. Even though most of the CD-ROMs were more appropriate for elementary school students, and it is believed that there is very little learning that can be measured with these programs (Klawe, 1996), these CD-ROMs were chosen because they were the only mathematically related programs available at the university.

Procedures

The information for this study was gathered during the spring of 1996. Two hypermedia assignments and two non-hypermedia assignments were given during the semester to provide information about the PSMTs' perceptions and attitudes toward the use of hypermedia in secondary mathematics instruction.

In the first non-hypermedia assignment, the students were asked to develop a lesson plan to be used in their teaching of mathematics and that modeled a real-life application. The non-hypermedia lesson plan was developed from information obtained from a newspaper. The mathematical concepts that the PSMTs implemented in their lesson involved statistics, interest rates on loans or investments, and a comparison of consumer purchases. Three weeks later the students developed another lesson plan, but they were required to use information obtained from the Internet. This was the first hypermedia assignment and was similar to the previous assignment because many of the PSMTs created a lesson plan that involved the same mathematical concepts as the non-hypermedia assignment.

In the second non-hypermedia assignment, the students were first given a list of six journals and were then asked to critique and summarize three articles. The summary included information pertaining to the mathematical concept(s) the author of the article discussed along with examples to explain any procedures. The students were also to determine the level of teaching for which the article was intended. The students were then asked to present one of the articles to the class and allow for discussion. To contrast summarizing published articles, three weeks later the PSMTs were also asked to do a similar assignment using hypermedia resources. The articles chosen were obtained from the Internet.

The second assignment helped the PSMTs become aware of mathematical ideas that teachers at the elementary, middle, and high school levels are implementing in their classrooms, and some of the research being conducted in teacher education. Most of the students were not even aware that these journals existed, so in addition to learning where to find supplementary material for their classrooms, they gained insight into their profession.

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Later in the semester, the PSMTs were also asked to review several CD-ROMs related to mathematics. Prior to reviewing the CD-ROMs, the PSMTs were given a definition of hypermedia and then completed a questionnaire in which they were asked to rank their knowledge of browsing the Internet, authoring on the Internet, and using CD-ROMs for both personal and instructional purposes. Upon the completion of the questionnaire, the PSMTs reviewed several CD-ROMs for two consecutive class periods. After examining the CD-ROMs, the PSMTs completed the same questionnaire that they were given prior to reviewing the CD-ROMs.

Measures

The questionnaire used to determine the PSMTs' knowledge of browsing the Internet, authoring on the Internet, and using CD-ROMs for both personal and instructional purposes was a Likert-type scale based on rankings from one to five, with one meaning little knowledge and five meaning expert knowledge. Examples of the questions about the PSMTs prior knowledge of some hypermedia data sources are provided in Table 2.

Please rank the following according to your level of knowledge.	
Use of the Internet:	Use of CD-ROMs:
• Web browsing	
Personal purposes 1 2 3 4 5	Personal purposes 1 2 3 4 5
Instructional purposes 1 2 3 4 5	Instructional purposes 1 2 3 4 5
• Web authoring	
Personal purposes 1 2 3 4 5	
Instructional purposes 1 2 3 4 5	

Table 2. Examples of questions to determine prior knowledge of hypermedia resources.

Two additional questions were included on the questionnaire to determine the PSMTs prior knowledge of hypermedia data sources. These questions are "What other hypermedia data sources have you used?" and "Where did you learn to use the hypermedia data sources with which you are familiar?" The PSMTs had indicated in these questions that the majority of their knowledge about hypermedia data sources was learned on their own, through friends or parents [computers], or other college courses.

Many of the questions on the part of the questionnaire used as both a pretest and a posttest, were revisions from the two Likert attitude scales, Attitudes Toward the Use of Computers in Schooling (ATSC) and Attitudes Toward Personal Use of Computers (ATPC) in Troutman (1991). The Cronbach alpha coefficients of reliability for these tests were $\alpha_R(ATSC) = .97$ and $\alpha_R(ATPC) = .90$. The revised questionnaire contained 24 of the 32 items from the ATSC and 12 of the 19 items from the ATPC with the exception of replacing "computer" with "hypermedia," although, some of the questions had to be completely reworded. There were eight additional questions added to the Attitudes Toward the Use of Hypermedia in Schooling (ATSH) item pool, and three additional questions added to the Attitudes Toward Personal Use of Hypermedia (ATPH) item pool. Each item was scored on a five-point scale with 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

The attitude measures were based on the total of item scores for each scale. On both scales, a high score indicated a positive attitude and a low score indicated a negative attitude. The initial responses for negative items were reversed so that the total item scores would coincide with the method used for finding total measures of attitudes. Questions were eliminated from the item pools if they related more to the general use of computers rather than to hypermedia. To test the stability of the revised questionnaire the Cronbach alpha coefficients of reliability were computed for each item: $\alpha_R(ATSH) = .77$ and $\alpha_R(ATPH) = .82$. The refined ATSH contains 29 items and the refined ATPH contains 13 items. (See Appendix A for a list of items on the ATPH and ATSH.) The possible range of scores on the ATSH scale was a high of 145 and a low of 29. The possible range of scores on the ATPH scale was a high of 65 and a low of 13.

Analysis of the Data

Data was collected from observations by the author, student work, informal discussions, and a questionnaire. These methods allowed the author to triangulate the PSMTs' perceptions.

Research Question 1. How do preservice mathematics teachers perceive the use of hypermedia in instruction? Data from the pretest questionnaire provided information about the PSMTs attitude toward the use of hypermedia in instruction. Data was also collected to determine the PSMTs prior knowledge about the use of hypermedia for personal and instructional purposes. Linear regression analysis was performed to determine the relationship between prior knowledge of hypermedia resources for personal and instructional purposes, and correspondingly, attitude toward personal use of hypermedia and attitude toward use of hypermedia in schooling.

Research Question 2. How does the use of hypermedia affect the attitudes of preservice mathematics teachers toward teaching? Data from the pretest and posttest questionnaires were compared and contrasted using paired t-tests to determine whether the PSMTs had changes in attitudes and perceptions toward the use of hypermedia in mathematics instruction.

Research Question 3. Does the PSMTs' vision of teaching change? Data was provided by student work collected throughout the course. The work included assignments involving both hypermedia and non-hypermedia resources. Each of the hypermedia assignments was similar to a non-hypermedia assignment which allowed a comparison to be made between the two resources. Comparison information was based on written critiques by the PSMTs and informal class discussions, and was used to determine whether hypermedia resources affected the PSMTs views about teaching.

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RESULTS

Findings from Quantitative Data Sources

Questionnaires. The results of the questionnaire which ranked the PSMTs' prior knowledge of hypermedia resources are provided in Table 3. These data indicate that the PSMTs had some knowledge about the use of the Internet in instruction and had more than average knowledge about the Internet for personal purposes. However, very few PSMTs had experience with authoring on the Internet for either personal or instructional purposes. The data to determine the prior knowledge about the use of CD-ROMs indicated that some PSMTs' knowledge and use of CD-ROMs for personal purposes was greater than other PSMTs, but there was very little known about the use of CD-ROMs for instructional purposes.

	Internet					
	Browsing		Authoring		CD-ROMs	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Personal Purposes	3.33	.231	1.50	.837	3.00	1.10
Instructional Purposes	2.83	.337	1.17	.183	1.83	.523

Table 3. Participants Prior Knowledge of the Internet and CD-ROMs.

Correlations

ATPH Pretest and Posttest. There were no significant correlations between the pretest and posttest scores on the ATPH: $t(5) = 1.15$, $p = .303$. The mean for the ATPH pretest was 49.00; for the ATPH posttest, 50.67. (Table 4.)

ATSH Pretest and Posttest. There were no significant correlations between the pretest and posttest scores on the ATSH: $t(5) = .44$, $p = .68$. The mean for the ATPH pretest was 104.50; for the ATPH posttest, 105.83. (Table 4.)

Personal Purposes and ATPH. There was a statistically significant, high, positive correlation between prior knowledge of hypermedia resources for personal purposes and attitude toward the personal use of hypermedia: $r = .883$, $t(5) = 3.763$, $p = .01$. That is,

those PSMTs who had personal knowledge about hypermedia resources also had a more positive attitude toward the personal use of hypermedia.

	Pretest		Posttest	
	Mean	S.D.	Mean	S.D.
ATSH	104.50	7.97	105.83	8.50
ATPH	49.00	5.51	50.67	2.94

Table 4. Means and standard deviations of ATSH and ATPH pretest and posttest scores.

Instructional Purposes and ATSH. There was no significant correlation between prior knowledge of hypermedia resources for instructional purposes and attitude toward the use of hypermedia in schooling: $r = .5$, $t(5) = 1.156$, $p = .156$.

Findings from Qualitative Data Sources

The PSMTs developed two lesson plans that could be used within their teaching of mathematics. One lesson plan used a non-hypermedia approach and the other used a hypermedia approach. A newspaper was the resource for the non-hypermedia assignment and the Internet was the resource for the hypermedia assignment. In the assignment, the PSMTs included reference to the URLs that they used. Table 5 provides a list of examples of some of the URLs from which the PSMTs developed their hypermedia-based lesson plans.

TITLE	URL
Ask Dr. Math	http://forum.swarthmore.edu/dr.math/
Frank Potter's Science Gems-Mathematics	http://www.sci.lib.uci.edu/SEP/math.html
Anywhere in the USA	http://www.cs.rice.edu/~radams/lessons/usa.html
A Catalog of Mathematics Resources on WWW and the Internet	http://mthwww.uwc.edu/wwwmahes/files/math01.html

Table 5. Examples of URLs used in developing lesson plans.

The PSMTs were later asked to critique the two methods for preparing lesson plans, discussing advantages and disadvantages to using the Internet. The following is a list of their responses addressing the question "What are the advantages and disadvantages of using the Internet when creating lesson plans as opposed to not using any technology in your lesson plan?"

> "Can view what other teachers are doing in their classrooms from all over the U.S. and abroad, so you can view others' lesson plans. Also, you don't have to go searching for a certain subject - you can just type in keywords."
>
> "You can dig up pre-planned lesson plans."
>
> "If you find a good interactive lesson and your school doesn't have computers - well then you must copy and readapt the lesson - or scratch it."
>
> "Computer breakdown, too much information, [and] can be overwhelming sometimes."
>
> "There is a lot of information available on the Internet. That's a plus. However, many of the sites that contain mathematics are either commercial and require a subscription in order to download the interesting material or do all the mathematics for the user and really require little mathematical thought. Despite these problems, it is beneficial to introduce students to the Internet early due to the fact that they will most likely encounter it in their careers."
>
> "If you are familiar with the Internet, the amount of information available and the ease at getting it is advantageous; however, not being familiar with it can make the search for information a lengthy, frustrating process, if you don't know where to look. No card catalog for the Internet exists."
>
> "Using the Internet I felt pretty overwhelmed and intimidated for quite awhile. There were so many possibilities that I had to approach (the Internet) part of the assignment differently. Using the paper was easier because I knew where to look for things and I could glance through it quicker. But, if I were trying to spruce up a lesson that I already had, I would probably rather use the Internet. I think I'd find a lot more things that would be interesting to students on it. I could tailor it to their needs."

In addition, the PSMTs were given a list of six different journals that related to teaching mathematics and research in teacher education. They were required to summarize and critique three journal articles of their choice, then present one of them to the class and allow for discussion. Later, they were asked to repeat the same assignment, but the articles

were required to be taken from the Internet. In the assignment, the PSMTs included reference to the URLs that they used. Table 6 provides a list of some of the URLs where the PSMTs found articles of interest about the teaching of mathematics.

TITLE	URL
Newton's Apple (Mazes)	http://www.mnonline.org/ktca/newtons/
What Curriculum for the 21st Century?	http://www.enc.org/online/ENC2016/2016.html
How School Mathematics Can Prepare Students for Work, Not Just for College	http://www.enc.org/online/ENC2409/2409.html
Helping Your Child Learn Math	http://www.ed.gov/pubs/parents/Math/index.html
Becoming a Teacher of Mathematics: A Constructive, Interactive Process	http://www.enc.org/online/journal.htm
Writing to Learn Mathematics	http://www.enc.org/online/ENC2177/2177.html

Table 6. Examples of URLs containing information about the teaching of mathematics.

The PSMTs were then asked to critique the two methods for finding articles in publications and articles on the Internet, discussing the advantages and disadvantages of each. The following is a list of their responses addressing the questions "What are the differences between finding articles in publications (e.g. journals) and articles on the Internet?" and "What are the advantages and disadvantages of each one?"

> "[The] Internet is a store-house of information. Articles can be accessed from many different sources - magazines, journals, newspapers, clubs, etc. all in one location - your computer."
>
> "Anyone can post anything on the Internet, so some things may not be necessarily publishable that you find."

"Not all journals are on the Internet, so there was not as wide a choice compared to going to the library, where I now know exactly where they are located. The journals that are on the Internet are easier to skim through because of the descriptive titles listed. There also seems to be more listed on the Internet (as far as general articles go) that I don't think are published in any journals."

"Well considering all the articles in publications are catalogued in various library computers, there is little difference. I did find that there is more available on-line. The journal articles in publications can be found on-line, for a price. However, [many] of the articles on the Internet are of a lesser caliber than those in publications. Much of it is just the unchallenged opinion of the author. Sometimes it seems that anyone can pass just about anything on the Net, whereas journals in publications require the approval of and are required to stand up to criticism from colleagues."

"Many of the articles on the Internet are written and published by individuals, and are not subject to the scrutiny journal publications are subject to before being published. The ability to jump to and from related articles on the Net is extremely helpful."

"It is easy to find information, find lots of types of information; don't have to go to the library."

Additional comments provided from some of the PSMTs about the assignments involving the development of lesson plans, and critiquing and summarizing articles are included in the following list.

"I thoroughly enjoyed reading these three articles. I have learned different ideas that can be used in the classroom and in teaching practice."

"The Internet can be very useful when studying many things. When using it, you seem to have any information that you need at your fingertips."

"Despite the many malfunctions of my computer during a three day period, I thoroughly enjoyed doing this assignment. I found many interesting articles and things to play with on the Internet."

Although many of the comments made by the PSMTs do not provide much support for or against using hypermedia resources in mathematics instruction, their comments suggest that they became more knowledgeable about their profession and have a better understanding of where to find additional information to create lesson plans. In addition, the PSMTs learned

more about technology and how it might get used within a classroom. Further comments about the ideas that the PSMTs had about using technology in mathematics instruction is provided in the following list.

> "Technology is a tool - to be used well or abused by the laborer (teacher). I still think writing a mathematical computer program is one of the most effective uses of this tool because of the process of writing the program - writing, debugging, running, debugging, writing, debugging, etc."
>
> "Technology can be overused in a classroom setting. Lesson plans on the Net are great for new teachers or teachers with students with difficulty in a particular subject."
>
> "Because of the power of new technological devices, we have a tendency to allow these devices to do all of our thinking for us. When teaching with technology as powerful as we have now, we must not totally change our teaching methods, just adjust them as to incorporate the technology."
>
> "I think if I do use the Internet for activities (which I'd like to do), I will have to take it in stages. After the first few weeks I might let them look around on Fridays, give them topics and pages to look for to get used to using it. Then I would give them in-class assignments to do using information from sources on the Internet. I think that them just getting their hands on a computer and getting used to it will help them later in a working situation."
>
> "I think as more and more people become familiar with the Internet, the easier and more beneficial it will be to use technology like this in the classroom. Knowing where to look seems like the biggest obstacle thus far."

Several of the comments made by the PSMTs indicate that they would like to have the opportunity to use technology in their classroom, and some comments suggest that they even have ideas on how it might get used within mathematics instruction. Most of them realize the importance of implementing technology so that it is effective and not allow the technology to replace the learning of basic mathematical concepts. Although the comments suggest that it is important for preservice teachers, as well as inservice teachers, to become familiar with the Internet, the comments also support the need to provide an index of resources on the Internet for teachers in order for the information to be more readily accessible.

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DISCUSSION

Perceptions of the Use of Hypermedia in Mathematics Instruction

The pretest questionnaire revealed that the majority of the students had only some knowledge about the use of hypermedia in mathematics instruction, but they had a positive attitude toward its use in schooling. In addition, many of the comments made by the PSMTs indicated that they had a positive attitude about using technology resources in mathematics instruction, but there were limitations to its effectiveness and appropriateness.

Use of Hypermedia and Attitude Toward Teaching

The general attitude of the PSMTs toward both personal and instructional use of hypermedia was positive prior to reviewing the CD-ROMs, and there was little change in their attitudes upon the completion of the review. Further analyses of individual scores revealed that 33.3% of the PSMTs' attitudes toward the use of hypermedia in schooling decreased from pretest to posttest, and 16.7% of the PSMTs' attitude toward the personal use of hypermedia decreased from pretest to posttest. Based on the negative comments made by some the PSMTs during the review, it is difficult to determine whether the PSMTs believed that CD-ROMs should not be used in secondary mathematics instruction or, if they believed that the mathematical concepts presented within those particular CD-ROMs were not appropriate for secondary mathematics instruction.

Since some of the PSMTs were already familiar with many of the CD-ROMs currently available in the market, more than likely, the mathematical concepts presented in the CD-ROMs reviewed would not be of use in secondary mathematics instruction. It is suggested that as more appropriate programs for secondary mathematics instruction become available, research should be conducted to determine whether they would be useful in the mathematics classroom.

Vision of Teaching

There was no change in the PSMTs' vision about teaching. The majority of the PSMTs were familiar with several technologies which affected their attitudes toward personal

use of hypermedia, but there was no correlation between knowledge of hypermedia for instructional purposes and their attitudes toward the use of hypermedia in instruction. The majority of the PSMTs felt that technology should be used in the mathematics classroom, but it is a tool that should be used to enhance instruction, and not be overused or allowed to replace the learning and teaching of basic mathematical concepts. Many of the PSMTs did agree, though, that it is important for students to gain experience working on the computer because it will help them in their careers.

Discussion on Qualitative Findings

The PSMTs comments about using technology in instruction suggest that the Internet can be useful in teaching and creating lesson plans, but that there are limitations to using this type of technology in mathematics instruction. In addition, many PSMTs commented that it is not only important for oneself to become familiar with the information that is available on the Internet, but one should know how to make adjustments in classrooms without computer facilities. The responses further suggest that it may be useful to have available on the Internet an index of resources for preservice and inservice teachers so that those who are less familiar with technology will not be too overwhelmed while finding information.

Although many of the comments made by the PSMTs about finding journal articles indicate that it is easier to access information through the Internet and some believed there was more information available, one needs to be able to distinguish between the information that is fact and that which is opinion. It is also important to understand how to use the information effectively.

Overall, the results of the comments by the PSMTs suggest that teachers can learn to appropriately use the Internet and other technologies in instruction, but that they should be educated about their uses during their preservice program. Many of the PSMTs comments also suggest that it would be beneficial to have an index of resources available on the Internet so that teachers can more easily access information for use in their classrooms.

The findings of this study support other studies which have found that the use of technology can be valuable in education. However, there is a continuing challenge for teacher educators to keep current with the available technologies and to implement them in a teacher education program. In addition, there is a challenge for teachers to understand the connection between the knowledge and skills acquired in their preservice courses and applying that information in the classroom. The introduction of technologies in teacher education programs may help in making this connection because of the ability of technology to provide a link between inservice and preservice teachers, and a link between all levels of mathematics instruction.

CONCLUSIONS

The results of this study provided some insight into understanding preservice secondary mathematics teachers' perceptions about the use of hypermedia in mathematics instruction. Although many of the PSMTs had previous experience working with technology resources, some had no experience working on the Internet or using CD-ROMs. Thus, it was advantageous to allow the PSMTs to gain experience using some newer technology resources and gain an understanding of how it might be used in the classroom. The increasing use of technology in society places a large demand on educational institutions to implement technologies in their classes in order for students to become educated about technology resources and so that students are better prepared to enter the work environment. By introducing technology in a preservice teacher program, teachers will acquire knowledge about technology resources and their applications in mathematics instruction.

Although the results of this study provided some supporting evidence that there is a need to introduce preservice secondary mathematics teachers to computer technology so that they may integrate technologies in their classrooms, it is evident that research is needed to determine whether hypermedia resources are effective in mathematics instruction and if so, how they should be used and when they are appropriate for the classroom.

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APPENDIX A

Attitudes Toward Personal Use of Hypermedia

	Strongly Disagree				Strongly Agree
1. I would almost rather do anything than to use hypermedia.	1	2	3	4	5
2. People who use hypermedia are computer wizards.	1	2	3	4	5
3. Hypermedia is easy to learn.	1	2	3	4	5
4. Hypermedia is easy to understand.	1	2	3	4	5
5. I think it is fun to use hypermedia.	1	2	3	4	5
6. Hypermedia can do some good for just about anyone.	1	2	3	4	5
7. I am afraid to use hypermedia.	1	2	3	4	5
8. I understand concepts better when hypermedia is used.	1	2	3	4	5
9. I don't feel sure of myself when it comes to learning hypermedia.	1	2	3	4	5
10. I think I can be more productive if I learn to use hypermedia.	1	2	3	4	5
11. Hypermedia is very interesting.	1	2	3	4	5
12. I am afraid that I cannot learn to use hypermedia.	1	2	3	4	5
13. I would like to use hypermedia data sources as much as possible.	1	2	3	4	5

Attitudes Toward Use of Hypermedia in Schooling

	Strongly Disagree				Strongly Agree
1. I am aware of the uses of hypermedia in instruction.	1	2	3	4	5
2. I would feel comfortable using hypermedia in my classroom.	1	2	3	4	5
3. Students learn better when hypermedia is used in the classroom.	1	2	3	4	5
4. Hypermedia would be easy to implement in my classroom.	1	2	3	4	5
5. I feel confident that I could organize instruction for my students using hypermedia.	1	2	3	4	5
6. Many teachers will not be able to learn to use hypermedia in their classrooms no matter how they try.	1	2	3	4	5
7. With the right hypermedia data sources, students could develop more confidence in their ability to learn.	1	2	3	4	5
8. With the right hypermedia data sources, students could learn to take greater responsibility for their own progress.	1	2	3	4	5
9. Lessons using hypermedia can be effective because they can correct student errors in a private impersonal way.	1	2	3	4	5

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	Strongly Disagree				Strongly Agree
10. Hypermedia will replace traditional instruction.	1	2	3	4	5
11. If we had better trained teachers we would not have to worry about using computers and hypermedia in education.	1	2	3	4	5
12. Students who use hypermedia to learn with will become passive students.	1	2	3	4	5
13. Hypermedia should never be used in instruction.	1	2	3	4	5
14. Effective teachers do not need to use hypermedia in their teaching. .	1	2	3	4	5
15. The use of hypermedia in schooling will erode the privacy of students.	1	2	3	4	5
16. Students who learn using hypermedia will have a definite advantage in life over students who have not learned to use hypermedia.	1	2	3	4	5
17. If hypermedia is used in schooling, students will not develop basic skills.	1	2	3	4	5
18. Training teachers to use hypermedia should be a high priority.	1	2	3	4	5
19. With hypermedia we have the opportunity to improve instruction.	1	2	3	4	5
20. The evil of hypermedia in schooling is that it will eventually replace a lot of good teachers.	1	2	3	4	5
21. School students would find learning with hypermedia challenging and interesting.	1	2	3	4	5
22. Hypermedia should never be used in instruction.	1	2	3	4	5
23. Lessons using hypermedia can be effective because they can correct student errors immediately.	1	2	3	4	5
24. Learning through the use of hypermedia is dull and repetitious.	1	2	3	4	5
25. Most teachers should learn to use hypermedia.	1	2	3	4	5
26. Using hypermedia in the classroom will create cold classroom atmospheres.	1	2	3	4	5
27. The use of hypermedia in schooling will decrease teachers workload.	1	2	3	4	5
28. Using hypermedia in schooling is just another fad that will be replaced with some other fad sooner or later.	1	2	3	4	5
29. Using hypermedia to teach is not anymore effective than using good books so why bother implementing it in schools.	1	2	3	4	5